IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants: Jill MacDonald Boyce

Examiner: An, S.

Serial No: 10/529,711

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For: IMPLICIT WEIGHTING OF REFERENCE PICTURES IN A VIDEO ENCODER

Mail Stop Appeal Brief-Patents
Hon. Commissioner for Patents
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APPEAL BRIEF

Applicants appeal the status of Claims 1, 3-9, 11, and 13-14 as presented in response to the Office Action dated November 6, 2006, and finally rejected in the Office Actions dated April 10, 2007 and the Advisory Action dated May 29, 2007. A Notice of Appeal was submitted on June 8, 2007 and Applicants now submit this appeal brief.

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1. Real Party in Interest

The real party in interest is THOMSON LICENSING S.A., the assignee of the entire right title and interest in and to the subject application by virtue of an assignment recorded with the Patent Office on March 29, 2005 at reel/frame 016953/0470.

2. Related Appeals and Interferences

None.

3. Status of Claims

Claims 1-14 are pending. Claims 1, 3-9, 11, and 13-14 stand rejected and are under appeal. Claims 2 and (10, and 12) have been objected as being dependent upon rejected base Claims 1 and 9, respectively, but would be allowable: if Claim 2 is rewritten in independent form including all of the limitations of the base claims 1 and any intervening claims; and if either Claim 10 or Claim 12 is rewritten in independent form including all of the limitations of the base Claim 9 and any intervening claims.

A copy of the Claims 1-14 is presented in Section 8 below.

4. Status of Amendments

An amendment under 37 CFR §1.111, mailed to the PTO on January 29, 2007 in response to the non-final Office Action dated November 6, 2006, was entered. A response under 37 C.F.R. §1.116, mailed to the PTO on May 7, 2007 in response to the final Office Action dated April 10, 2007, was considered but deemed to not place the application in condition for

allowance as indicated in an Advisory Action mailed on May 29, 2007. A Notice of Appeal was submitted on June 8, 2007. No Responses/Amendments were filed subsequent to the above Notice of Appeal submitted June 8, 2007.

5. Summary of Claimed Subject Matter

Claim 1 is directed to a video encoder for encoding video signal data for an image block and a plurality of reference picture indices (Claim 1, preamble).

The subject matter of Claim 1, in particular, the encoder is described, e.g., at page 8, line 4 to page 9, line 2, and the reference picture weighting factor assignor, is described, e.g., at: page 8, lines 15-19 and 31-33. Moreover, the subject matter of Claim 1 involves, e.g.: element 500, including element 572, of FIG. 5.

Claim 9 is directed to a method for encoding video signal data for an image block (Claim 9, preamble).

The subject matter of the first step of Claim 9 (starting with "receiving") is described, e.g., at: page 9, lines 6-7. Moreover, the subject matter of the first step of Claim 1 involves, e.g.: element 612 of FIG. 6.

The subject matter of the second step of Claim 9 (starting with "calculating") is described, e.g., at: page 9, lines 12-15. Moreover, the subject matter of the second step of Claim 1 involves, e.g.: element 618 of FIG. 6.

The subject matter of the third step of Claim 9 (starting with "computing") is described, e.g., at: page 9, lines 17-18. Moreover, the subject matter of the third step of Claim 1 involves, e.g.: element 622 of FIG. 6.

The subject matter of the fourth step of Claim 9 (starting with "motion compensating") is described, e.g., at: page 9, lines 18-20. Moreover, the subject matter of the fourth step of Claim 1 involves, e.g.: element 624 of FIG. 6.

The subject matter of the fifth step of Claim 9 (starting with "multiplying") is described, e.g., at: page 9, lines 21-23. Moreover, the subject matter of the fifth step of Claim 1 involves, e.g.: element 626 of FIG. 6.

The subject matter of the sixth step of Claim 9 (starting with "combining") is described, e.g., at: page 9, lines 26-27. Moreover, the subject matter of the sixth step of Claim 1 involves, e.g.: element 630 of FIG. 6.

The subject matter of the seventh step of Claim 9 (starting with "subtracting") is described, e.g., at: page 9, lines 27-29. Moreover, the subject matter of the seventh step of Claim 1 involves, e.g.: element 632 of FIG. 6.

The subject matter of the eighth step of Claim 9 (starting with "encoding") is described, e.g., at: page 9, lines 30-33. Moreover, the subject matter of the eighth step of Claim 1 involves, e.g.: element 634 of FIG. 6.

6. Grounds of Rejection to be Reviewed on Appeal

Claims 1, 3-9, 11, and 13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,081,551 to Etoh (hereinafter "Etoh") in view of U.S. Patent No. 5,467,136 to Odaka et al. (hereinafter "Odaka"). Moreover, Claim 14 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Etoh and Odaka as applied to Claim 9, and further in view of U.S. Patent No. 6,782,054 to Bellers (hereinafter "Bellers"). The preceding rejections are

presented for review in this Appeal.

Regarding the grouping of the Claims, Claims 3-8 stand or fall with Claim 1, and Claims 11 and 13-14 stand or fall with Claim 9, due to their respective dependencies. As noted above, Claims 2, 10, and 12 have been objected to, but deemed allowable.

7. Argument

A. Introduction

In general, the present principles are directed to implicit weighting of reference pictures in a video encoder (Applicants' Specification, Title). As disclosed in the Applicants' specification, the present invention is directed to weighting factors, since, "in some video sequences, particularly those with fades, the current picture to be coded or decoded is more strongly correlated with the reference picture scaled by a weighting factor than with the reference picture itself" (Applicant's specification, p. 1, lines 20-22). Moreover, "[w]hen weighting factors are used in encoding, a video encoder needs to determine both the weighting factors and motion vectors" (Applicant's specification, p. 3, lines 3-5).

Accordingly, the present principles provide a novel approach to calculating implicit weighting factors, wherein the distances of the current picture from the reference picture(s) are used to determine the relative weighting factors (Applicant's specification, e.g., p. 5, lines 25-30, and p. 9, lines 10-14).

The claims of the pending invention include novel features not shown in the cited references and that have already been pointed out to the Examiner.

It is respectfully asserted that Claims 1, 3-9, 11, and 13-14 are patentably distinct and

non-obvious over the cited references, as will be shown herein below. As such, Claims 1, 3-9, 11, and 13-14 are presented for review in this appeal.

B. Rejection Under 35 U.S.C. §103(a) Over U.S. Patent No. 6,081,551 in view of U.S. Patent No. 5,467,136

"To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art" (MPEP §2143.03, citing *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)). "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious" (MPEP §2143.03, citing *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)).

The Examiner rejected Claims 1, 3-9, 11, and 13 as being unpatentable over U.S. Patent No. 6,081,551 to Etoh in view of U.S. Patent No. 5,467,136 to Odaka et al. The Examiner contends that the combination of Etoh and Odaka shows all the elements recited in these claims.

Etoh is directed to image coding and decoding apparatus and methods thereof (Etoh, Title). To that end, Etoh discloses, in the Abstract thereof, an apparatus that comprises the following:

> motion detecting means for detecting a motion vector for each block of a prescribed size from a reference image and an input image; weighted motion compensation means for, based on the detected motion vector, extracting from the reference image an area of a prescribed size which is wider than the prescribed block size and which contains an area corresponding to each block of the input image, and for creating a predicted image for the input image by applying a

> predetermined weight to each of pixels in the wider area and by using the weighted pixels of the wider area; a predicted-image memory for storing the predicted image; encoding means for taking a residual between the stored predicted image and the input image, and for encoding the residual; and decoding means for decoding the encoded image data and thereby obtaining a reference image.

Odaka is directed to a video decoder for determining a motion vector from a scaled vector and a difference vector (Odaka, Title). To that end, Odaka discloses the following in his Abstract:

> A video decoding apparatus including a memory for storing at least first and second reference pictures, a prediction signal forming circuit for forming a prediction signal to produce an output signal, using a first reference signal designated by a first motion vector for the first reference picture and a second reference signal designated by a second motion vector for the second reference picture read out of the memory. Also included is a decoding circuit for decoding the transmitted first motion vector and a transmitted motion vector difference, and for further decoding the second motion vector by adding a scaled motion vector and the motion vector difference. The scaled motion vector is derived by scaling the first motion vector to a motion vector for the second reference picture. Further included is a decoding circuit for decoding a transmitted difference signal and for

obtaining the output signal by adding the difference signal and the prediction signal.

It will be shown herein below that the limitations of the Claims 1 and 9 reproduced herein are not shown in Etoh and/or Odaka, and that such Claims should be allowed including those dependent there from as identified in Section 6 herein.

B1. Claims 1, 3-9, 11, and 13-14

It is respectfully asserted that none of the cited references, either taken singly or in any combination, teach or suggest the following limitations recited in independent Claim 1:

> a reference picture weighting factor assignor responsive to the relative positioning between the image block and first and second reference pictures indicated by the plurality of reference picture indices, the reference picture weighting factor assignor for calculating respective implicit weighting factors for the first and second reference pictures based on respective distances of the image block to the first and second reference pictures.

It is respectfully asserted that none of the cited references, either taken singly or in any combination, teach or suggest the following limitations recited in independent Claim 9:

> calculating implicit weighting factors for the image block responsive to the relative positioning between the image block and first and second reference pictures indicated by first and second reference picture indices_based on respective distances of the image block to the first and second reference pictures;

The Examiner has made the following correlations between the above-recited limitations of Claim 1 and Etoh, as set forth at page 2 of the Office Action:

> a reference picture weighting factor assignor (22a, 22b) responsive to the relative positioning between the image block (input image to 22a and 22b via 21a and 21b) and first and second reference pictures indicated by the plurality of reference picture indices (23, 24), wherein the reference picture weighting factor assignor determines respective implicit weighing factors for the first and second reference pictures (FIG. 5).

It is to be noted that the preceding portion of Claim 1 reproduced by the Examiner in the Office Action does NOT represent the exact limitations recited therein.

The Examiner has made the following correlations between the above-recited limitations of Claim 9 and Etoh, as set forth at page 4 of the Office Action:

> determining implicit weighting factors (22a, 22b, Fig. 5) for the image block responsive to the relative positioning between the image block (Input Image

to 22a and 22b via 21a and 21b, respectively) and first and second reference pictures indicated by the plurality of reference picture indices (23, 24)

It is to be noted that the preceding portion of Claim 9 reproduced by the Examiner in the Office Action does NOT represent the exact limitations recited therein.

Nonetheless, in the case of both Claims 1 and 9, the Examiner has admitted that "Etoh does not particularly disclose calculating respective implicit weighting factors for the first and second reference pictures based on respective distances of the image block to the first and second reference pictures" (Office Action, p. 3, lines 1-3 and p. 4, lines 24-26).

Accordingly, the Examiner has relied upon Odaka as disclosing the preceding limitations the Examiner has stated are not disclosed in Etoh.

In particular, with respect to both Claims 1 and 9, the Examiner has stated "Odaka et al teaches a video coding apparatus which forms an optimum prediction signal which is designated by a set of motion vectors of separate reference pictures comprising calculating respective implicit weighting factors (FIG. 1, 31-32) for the first (15) and second (16) reference pictures based on respective distances (FIG. 26, n and n-1) of the image block to the first and second reference pictures for preventing a deterioration in prediction performance (col. 7, lines 29-47; col. 21, lines 2-45)" (Office Action, p. 3, lines 4-9, and p. 4, line 27 to p. 5, line 2).

The Applicants respectfully disagree with the Examiner's reading of Odaka and, further, respectively assert that Odaka does not even remotely teach or suggest the preceding limitations of Claims 1 and 9.

The Applicants immediately hereinafter reproduce the cited textual sections of Odaka for the Examiner's convenience.

Column 7, lines 29-47 of Odaka disclose the following (emphasis added):

> The interpolation circuit 19 comprises an intra-field interpolation circuit 30, multipliers 31 and 32, and an adder 33. The interpolation circuit 19 forms the reference video signal 12 by mixing a signal, formed by the intra-field interpolation circuit 30 using an output signal from the field memory 15, with an output signal from the field memory 16 at a mixing ratio of k:1-k.
>
> <u>The motion vector candidate 18 output from the motion vector searching circuit 17 is also input to the interpolation circuit 19 to control a parameter k for determining the mixture ratio between output signals from the field memories 15 and 16.</u> More specifically, if the vertical component of the motion vector candidate 18 corresponds to intra-field n+½ lines (n is an integer), control is performed to set k=l so that a corresponding pixel value stored in the field memory 15 (in this case, it is assumed that a video close to a to-be-coded video is stored in the field memory 15) is directly output as the reference video signal 12.

Column 21, lines 20-45 of Odaka disclose the following (emphasis added):

> <u>FIG. 26 shows a detailed example of how the abovementioned motion vector is transmitted</u>, in which the difference (indicated by the arrow (difference

vector d) extending in the vertical direction in FIG. 26) between a motion vector with a precision of one pixel (indicated by the arrow (motion vector b) on the lower side in FIG. 26) in the reference field #2 and a point "•" nearest to a point "Δ" at which a motion vector with a precision of ½ pixels (indicated by the arrow (motion vector a) on the upper side in FIG. 26) in the reference field #1 crosses the reference field #2 is transmitted with a precision of one pixel. In the case shown in FIG. 26, the difference is -1. With this operation, the data amount of a motion vector can be saved without causing a deterioration in prediction performance.

In summary, the variable length coder 713 subjects the base vector of motion vector data sent from the second motion vector detector 711 to a variable length coding without any modification. However, as for coding of nonbase vector of the motion vector data, the base vector is scaled into a motion vector in the non-base field, a difference between the non-base vector and the scaled motion vector is calculated and it is subjected to the variable length coding. The motion vector data includes the field parity data described above. In addition, the prediction mode data is also sent from the second motion vector detector 711. These data are also subjected to a variable-length coding.

Thus, in Figure 1 of Odaka, blocks 31 and 32 assign weights to two fields, basing the weighting factors upon the value of the motion vector. For example, as explained at column 7, lines 36-41 of Odaka with respect to Figure 1, "The motion vector candidate 18 output from the

motion vector searching circuit 17 is also input to the interpolation circuit 19 to control a parameter k for determining the mixture between output signals from the field memories 15 and 16." Thus, it is clear that the cited sections of Odaka disclose that the weighting factor assignment is based on a motion vector value, and NOT "based on respective distances of the image block to the first and second reference pictures" as explicitly recited in Claims 1 and 9.

Moreover, with respect to Figure 26 and column 21, lines 20-45 of Odaka, while the same discloses the use of relative field distances, such use is for an operation completely unrelated to assigning weights, namely such use is disclosed for implementing variable length coding of motion vectors for transmission. For example, Figure 26 and column 21, lines 20-45 of Odaka disclose how a motion vector value is coded for transmission, using differential values based upon relative field distances, and applying variable length coding to the base vector and difference between the scaled vector and the base vector, which has nothing to do with assigning weights to reference pictures as recited in Claims 1 and 9.

Further, column 23, lines 22-44 of Odaka, which correspond to Figure 6 of Odaka, and which were not explicitly cited by the Examiner, are nonetheless reproduced as follows:

> In FIG. 26, the field distance between the base field #1 and the field being decoded (this field has been referred to a to-be-coded field for descriptive convenience for coding) can be calculated, using the field number of base field #1 and that of the field being decoded, and the data indicating the prediction direction of the field being decoded. Assume that this field distance is "n". In this case, <u>to scale a motion vector</u> <u>a</u> to the reference field #1 serving as the base field into a

motion vector to the reference field #2 serving as the non-base field, the following expression is calculated, and the resultant fraction is rounded to a nearest point, as indicated by a vector c to a black dot in FIG. 26.

(Motion Vector to Base Field #1)X(n-1)/n

The motion vector to the reference field #2 serving as the non-base field is obtained by adding the difference vector d (-1 in FIG. 26) to the scaled and rounded motion vector c. Referring to FIG. 26, if the reference field #2 is the base field, the motion vector to the base field #2 is multiplied with (n+l)/n to perform scaling into the motion vector to the reference field #1 serving as the non-base field. Either case is selected from the field parity data.

Thus, Figure 26 and column 23, lines 22-44 of Odaka disclose the calculation of a scaled motion vector based upon relative field distances. That is, the preceding section of Odaka discloses the scaling of motion vectors based on relative distances, and not determining weighting factors to apply to reference pictures based on relative distances from an image block to the reference pictures as essentially recited in Claims 1 and 9.

Etoh does not cure the deficiencies of Odaka, and is silent with respect to the above-recited limitations of Claims 1 and 9. For example, as admitted by the Examiner as noted above, "Etoh does not particularly disclose calculating respective implicit weighting factors for the first

and second reference pictures based on respective distances of the image block to the first and second reference pictures" (Office Action, p. 3).

Thus, neither Etoh nor Odaka, either taken singly or in combination, teach or suggest the above-recited limitations of Claims 1 and 9.

Accordingly, Claims 1 and 9 are patentably distinct and non-obvious over the cited references for at least the reasons set forth above. Therefore, withdrawal of the rejection and allowance of Claim 1 (and, thus, also Claims 3-8) and Claim 9 (and, thus, also Claims 11 and 13-14) is earnestly requested.

C. Conclusion

At least the above-identified limitations of the pending claims are not disclosed or suggested by the teachings of Etoh and/or Odaka. Accordingly, it is respectfully requested that the Board reverse the rejection of Claims 1, 3-9, 11, and 13-14 under 35 U.S.C. §103(a).

Please charge the amount of $500.00, covering fee associated with the filing of the Appeal Brief, to **Thomson Licensing Inc., Deposit Account No. 07-0832**. In the event of any non-payment or improper payment of a required fee, the Commissioner is authorized to charge **Deposit Account No. 07-0832** as required to correct the error.

Respectfully submitted,

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8. CLAIMS APPENDIX

1. (previously presented) A video encoder for encoding video signal data for an image block and a plurality of reference picture indices, the encoder comprising a reference picture weighting factor assignor responsive to the relative positioning between the image block and first and second reference pictures indicated by the plurality of reference picture indices, the reference picture weighting factor assignor for calculating respective implicit weighting factors for the first and second reference pictures based on respective distances of the image block to the first and second reference pictures.

2. (previously presented) A video encoder as defined in Claim 1 wherein the reference picture weighting factor assignor comprises:

an interpolation portion for interpolating between portions of two reference pictures disposed one before and one after the image block in display order; and

an extrapolation portion for extrapolating from portions of two reference pictures disposed both before or both after the image block in display order.

3. (previously presented) A video encoder as defined in Claim 1, further comprising a reference picture store in signal communication with the reference picture weighting factor assignor for providing a reference picture corresponding to each reference picture index.

4. (previously presented) A video encoder as defined in Claim 1, further comprising a variable length coder in signal communication with the reference picture weighting factor assignor for encoding the first and second reference picture indices.

5. (previously presented) A video encoder as defined in Claim 1, further comprising a motion compensation unit in signal communication with the reference picture weighting factor

assignor for providing motion compensated reference pictures responsive to the reference picture weighting factor assignor.

6. (previously presented) A video encoder as defined in Claim 5, further comprising a multiplier in signal communication with the motion compensation unit and the reference picture weighting factor assignor for applying a weighting factor to a motion compensated reference picture.

7. (previously presented) A video encoder as defined in Claim 6, further comprising prediction means for forming first and second predictors from two different reference pictures.

8. (previously presented) A video encoder as defined in Claim 7 wherein the two different reference pictures are both from the same direction relative to the image block.

9. (previously presented) A method for encoding video signal data for an image block, the method comprising:

receiving a substantially uncompressed image block;

calculating implicit weighting factors for the image block responsive to the relative positioning between the image block and first and second reference pictures indicated by first and second reference picture indices_based on respective distances of the image block to the first and second reference pictures;

computing motion vectors for the image block and each of the first and second reference pictures;

motion compensating each of the first and second reference pictures in correspondence with the respective motion vectors;

multiplying each of the motion compensated reference pictures by its calculated implicit weighting factor to form a weighted motion compensated reference picture;

combining each of the weighted motion compensated reference pictures into a combined weighted motion compensated reference picture;

subtracting the combined weighted motion compensated reference picture from the substantially uncompressed image block; and

encoding a signal indicative of the difference between the substantially uncompressed image block and the combined weighted motion compensated reference picture along with the corresponding indices of the first and second reference pictures.

10. (original) A method as defined in Claim 9 wherein calculating an implicit weighting factor comprises at least one of:

interpolating between portions of two reference pictures disposed one before and one after the image block in display order; and

extrapolating from portions of two reference pictures disposed both before or both after the image block in display order.

11. (original) A method as defined in Claim 9 wherein motion compensating each of the retrieved reference pictures comprises determination of motion vectors for the retrieved reference pictures relative to the image block.

12. (original) A method as defined in Claim 9, further comprising:

encoding a picture order count in a slice header field for the image block for use in calculating implicit weighting factors for the image block and the plurality of reference pictures.

13. (original) A method as defined in Claim 9 wherein the relative positioning of the image block and the plurality of reference pictures corresponds to the relative display times of the respective pictures.

14. (previously presented) A method as defined in Claim 9 wherein computing motion vectors comprises:

testing within a search region for every displacement within a pre-determined range of offsets relative to the image block;

calculating at least one of the sum of the absolute difference and the mean squared error of each pixel in the image block with a motion estimated reference picture; and

selecting the offset with the lowest sum of the absolute difference and mean squared error as the motion vector.

9. RELATED EVIDENCE APPENDIX

None.

10. <u>RELATED PROCEEDINGS APPENDIX</u>

None